PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)
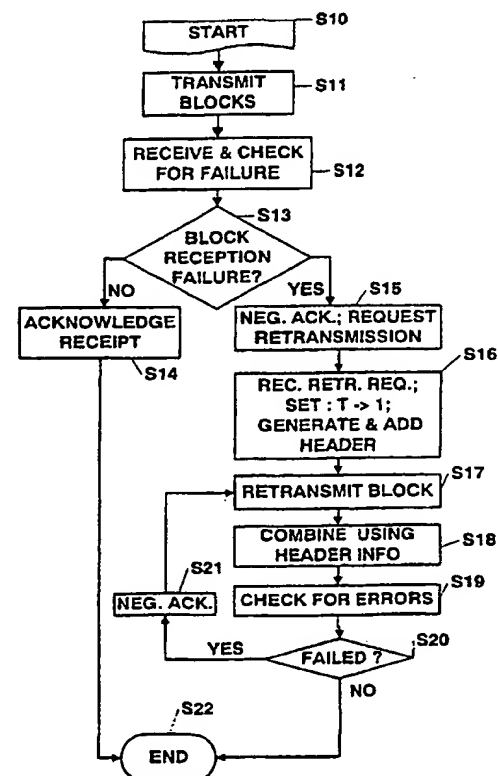
(54) Title: SIGNALING METHOD IN AN INCREMENTAL REDUNDANCY COMMUNICATION SYSTEM WHEREBY DATA BLOCKS CAN BE COMBINED

(57) Abstract

The present invention proposes a method of signaling which data blocks can be combined together in an incremental redundancy communication system consisting of a transmitter device and a receiver device, the method comprising the steps of: transmitting (S11) said blocks (B1, B2, ...Bn) from a transmitter device to a receiver device, with each transmitted data block including an information (T) indicating whether a respective data block is transmitted for a first time or is a retransmitted block; checking (S12, S13), at said receiver device, whether the transmission of a respective data block (B1) has failed; requesting (S16) a retransmission of said data block from the transmitter device if said transmission of said respective block has failed, and in response to receiving said retransmission request at the transmitter device side, setting (S17) said information (T) to a value indicating that said respective data block is a retransmitted block, and adding (S17) at least one header to said data block to be retransmitted, said header representing a reference to a physical location of an earlier transmission of said block in a sequence of transmitted blocks. By virtue of the proposed method and accordingly adapted transmitter and receiver devices of a corresponding communication system, transmitting of a block number within a respective data block can be dispensed with, thereby reducing an overhead of transmitted data and increasing user data throughput in the communication system.

SIGNALLING METHOD IN AN INCREMENTAL REDUNDANCY COMMUNICATION SYSTEM WHEREBY DATA BLOCKS CAN BE COMBINED

FIELD OF THE INVENTION

5

The present invention relates to a method of signaling which data blocks can be combined together in a communication system consisting of a transmitter device and a receiver device. In particular, the present invention

10   relates to such a method applied to combinable blocks transmitted in an incremental redundancy communication system.

BACKGROUND OF THE INVENTION

15

The expression of combining as used in connection with the present application is intended to be understood as code combining. This means the combining of data (e.g. data bits) received via a channel during an original

20   transmission together with the data (data bits) received via the channel during a retransmission of the data. After such a combining of data has been effected, channel decoding is performed based on the information from both transmissions and only then the received data block is

25   checked for errors.

Furthermore, the expression incremental redundancy means a method of adapting a code rate, i.e. an amount of coding adopted in a communication system having a channel with varying transmission conditions.

30   varying transmission conditions.

Referring to a general example, a block of data is assumed to be coded with a code rate of 1/2. Then, one half of this coded data is sent during an initial (original) transmission. At a receiver side, received data are

35

perceived as having a code rate of 1/1. At a retransmission
(if necessary upon failure in the original transmission),
the other half of the coded data is transmitted, combined
to the first half of the data block, and then a code rate

5   of 1/2 is recognized at the receiver side. Such a combining
then increases the amount of total coding in incremental
redundancy systems.

       Fig. 1 of the drawings illustrates a conventional

10   transmission system denoted with numeral 1. Generally, a
communication system 1 consists of a transmitter device 1A
and a corresponding receiver device 1B. Transmission of
data between these devices takes place via a transmission
channel 1C established there between.

15

       A communication method adopted by such a communication
system is explained below with reference to Fig. 1, in
which the respective steps are indicated by numbers (1) to
(4). According to such a conventional communication method

20   data are transmitted in units of blocks (also referred to
as packetized data) via the channel with some channel
coding. Namely, as indicated in step (1), a (first) data
block #1 containing data X is sent from the transmitter
device 1A to the receiver device 1B. If the receiver device

25   1B is not able to receive the transmitted block #1, a
corresponding notification indicating this transmission
error or failure, respectively, is returned to the
transmitter device 1A. This notification is also called
negative acknowledgment and represents a retransmission

30   request upon a reception failure (step (2)). In response
thereto, the transmitter device 1A in step (3) then
transmits another block (data block #2) containing the same
data X as contained in the (previous) data block #1. For
this transmission, possibly an other coding can be used.

35   The receiver device 1B in turn combines the data blocks

received so far (step (4)), i.e. data block #1 is combined
with data block #2, and tries to decode the retransmitted
block again. This combining, as already mentioned above in
connection with the general example, effectively increases
5   the amount of total coding and thus decreases the
probability of further errors.

However, since a subsequent data block containing the next
data is only transmitted after a preceding block has been
10   successfully transmitted or retransmitted, the whole
communication procedure is somewhat delayed and the data
rate that can be transmitted is reduced.

In order to reduce the delay and increase transmission
15   rate, another prior art method and corresponding system has
been proposed, according to which a plurality of blocks are
transmitted in sequence without waiting for the respective
acknowledgment. However, in such a situation, a
retransmitted data block does not immediately follow the
20   original one.

Consequently, the receiver device 1B of the communication
system does not automatically know which data blocks can be
combined with each other.
25
Fig. 2 schematically exemplifies a prior art method which
has been developed to cope with this problem.

According to this known method, each data block B0, B1,
30   ..., Bn in the sequence of transmitted data blocks is
assigned a sequence number or block number BN. In case
there occurs an error in transmission or a reception
failure in connection with an initial (first) or original
transmission of a subject data block and a retransmission
35   is requested, the retransmission is assigned the same

number as the original transmission. The block numbers have
to be coded more robustly, i.e. with higher redundancy, so
that the probability that the receiver is unable to decode
or recognize the block number is reduced to a minimum.

5

Thus, provided that the receiver device has received the
block numbers, the blocks that have the same number can be
combined with each other.

10   Specifically, with reference to the example of Fig. 2, a
sequence of four data blocks containing data X, Y, and/or Z
is transmitted at time instants 0, 1, 2, and 3. The first
block B0 to which a block number BN of 546 has been
assigned for the specific example, is assumed to have not
15   been received correctly, so that its transmission has to be
repeated.

The retransmission of said data block identified by BN=546
occurs at a time instant "2". At this time, the block is
20   retransmitted as indicated by the identical block number of
BN=546 at time instant "2" and the data block contains the
same data X as in the initial transmission at time instant
"0".

25   However, there is a disadvantage of this known method in
that the amount of data that can be transmitted is reduced
due to the additional overhead represented by the adopted
block numbering which has to be transmitted in form of the
block numbers BN together with each data block B0, ..., Bn.

30

Moreover, even in case the transmission quality of the
channel is as high that no errors occur, the block
numbering still reduces the amount of user data that can be
transmitted in the communication system.

35

SUMMARY OF THE INVENTION

Hence, it is an object of the present invention to provide
a method of signaling which data blocks can be combined
together in an incremental redundancy communication system
consisting of a transmitter device and a receiver device,
which is free from the above mentioned drawbacks and
enables an increased data throughput. Moreover, it is an
object of the present invention to provide a corresponding
communication system.

According to the present invention, this object is achieved
by a method of signaling which data blocks can be combined
together in an incremental redundancy communication system
consisting of a transmitter device and a receiver device,
the method comprising the steps of transmitting said blocks
from a transmitter device to a receiver device, with each
transmitted data block including an information indicating
whether a respective data block is transmitted for a first
time or is a retransmitted block; checking, at said
receiver device, whether the transmission of a respective
data block has failed; requesting a retransmission of said
data block from the transmitter device if said transmission
of said respective block has failed, and in response to
receiving said retransmission request at the transmitter
device side, setting said information to a value indicating
that said respective data block is a retransmitted block,
and adding at least one header to said data block to be
retransmitted, said header representing a reference to a
physical location of an earlier transmission of said block
in a sequence of transmitted blocks.

Also, this object is achieved by a communication system
consisting of a transmitter device and a receiver device,
each adapted to carry out the above method.

Favorable refinements of the present invention are as defined in the dependent claims.

5   Thus, according to the present invention it is advantageously possible to eliminate the need for each original block to contain block numbering information. Consequently, the previously present overhead due to block numbering can be significantly reduced, thereby increasing
10 the user data throughput in the communication system. The only overhead needed in the original transmission of respective data blocks is a flag that can be represented by a single bit only. Thus, in case where a retransmission is not required, the overhead is reduced to a negligible and
15 minimum overhead in the proposed incremental redundancy system.

The proposed method may further advantageously be applied to nearly any communication system in which data are
20 transmitted in units of blocks or as so called packets.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be more readily understood when
25 referring to the enclosed drawings, in which:

Fig. 1 schematically shows a block diagram of and communication steps performed by a conventional communication system;
30
Fig. 2 illustrates in principle a data format used for data blocks transmitted according to a further communication method known in the art;

Fig. 3 represents a flowchart of the method according to
the present invention;

Fig. 4 illustrates in principle a data format used for data
5   blocks transmitted according to an embodiment of the
present invention;

Fig. 5A illustrates in principle a data format used for
data blocks transmitted according to two further
10   embodiments of the present invention;
Fig. 5B illustrates in principle a data format used for
data blocks transmitted according to a still further
variation of the present invention obtained by a
combination of the presented embodiments; and
15   Fig. 5C illustrates in principle a data format used for
data blocks transmitted according to another modification
representing an additional embodiment of the present
invention.

20   <u>DETAILED DESCRIPTION OF THE EMBODIMENTS OF THE INVENTION</u>

According to the present invention, block numbers are
advantageously no longer needed to be transmitted with
extra redundancy. Stated in other words, block numbers are
25   not needed for the code combining function, while they may
nevertheless be retained, if they are needed for other
functions implemented on higher layers.

A transmitter device and a receiver device of a
30   communication system both agree on a numbering scheme,
which is based on a physical location of blocks in a
sequence of transmitted data blocks. The agreement on the
numbering scheme is for example reached in an initial
"handshaking" procedure performed between the receiver and
35   transmitter devices. Alternatively, the agreement can in a

- 8 -

preferred manner also be made during the design and
specification of the communication system, which thus
removes the signaling which is otherwise required in
connection with the handshaking.

5

Such a numbering scheme may for example be obtained by
mapping the time of transmission of each data block of the
transmitted sequence of data blocks to a number of the
numbering scheme. In this case, the transmission time of

10   the data block represents the physical location of said
retransmitted block in the sequence of transmitted blocks.

Alternatively, instead of time, also the transmission
frequency used for transmission can be mapped to a

15   corresponding numbering scheme, so that the used frequency
represents the physical location of said retransmitted
block in the sequence of transmitted blocks.

As a still further alternative, also the transmission code

20   used for transmission can be mapped to a corresponding
numbering scheme, so that the used code represents the
physical location of said retransmitted block in the
sequence of transmitted blocks.

25   Also, any combination of the above introduced numbering
schemes can be adopted, so that the numbering reflects a
combination of plural physical locations of a data block,
namely for example a location in the frequency domain, the
code domain and the time domain.

30

Still further, it is conceivable to adopt a block nested
scheme or hierarchical structure. For example, a number i
of transmitted blocks (also referred to as sub-blocks or
elementary blocks) is grouped to form a higher order block

35   (referred to as "block"), while a number k of such "blocks"

(which itself consist of the sub-blocks) may again be grouped to form for example a block arrangement called "hyper-block". Such grouping of elementary blocks can be effected for a respective single one of the above domains

5   represented by a physical parameter representing in turn the physical location of a respective block, or for a combination of plural of the domains.

Moreover, as regards the above mentioned alternatives,

10   there exists also the possibility of using differential references relative to the time/frequency/code of the retransmission in the retransmission. Stated in other words, there is no reference to the absolute physical location of the original transmission included in the

15   retransmission, but a differential (and/or relative) reference pointing to the original transmission in that the difference to the current physical location of the retransmission is indicated. Such a reference is also suitable since in practice there may be an infinite number

20   of time instants and not only a limited number of time instants as illustrated in the examples given below.

With a numbering scheme being based on the physical location of a block, in each block there is only one bit T

25   required which indicates whether the respective block is a new or original one (transmitted for the first time), T=0, or whether the respective block is a retransmitted one, T=1, that can be combined with (contains the same data as) a previously transmitted block which has not been received

30   or received with error.

Then, only in case of T=1 there is an additional header present in the block. The information contained in this header represents the physical number (location) of the

35   original (or, more generally, an earlier) transmission of

the block. Based on this number, the receiver can find the
original (earlier) transmission of the block and combine
the two blocks with each other.

5   Particularly, the presence of the (set) bit T serves for
the purpose of indicating the presence of the (additional)
header to the receiver device.

The header as well as the bit T are coded for transmission
10   via the transmission channel, so that they can be received
under nearly all channel conditions without error.

In case of a block nested numbering scheme, the bit T may
then be common to all sub-blocks in one block (and/or to
15   all blocks in a hyper-block). In such cases, it has to be
noted that the header then contains multiple references
such as, for example, an order of reference as follows:
hyper_block_reference, block_reference,
sub_block_reference, each represented by a corresponding
20   number. More precisely, let's assume a case in which 8 sub-
blocks form one block, four blocks form one hyper-block,
and the hyper-blocks are sequentially transmitted. Then, a
header may contain the following information (5, 3, 7),
which means that the original transmission occurred in the
25   seventh sub-block of the third block within the fifth
hyper-block.

Also, the number of data units or packets (within a e.g.
sub-block or block represented by a physical location) is
30   not necessarily the same for both values of T. This means
that a (sub-)block identified by a bit T=1 may contain
several data units (packets) which are retransmitted and
also a corresponding number of headers.

In connection with the bit T, this bit may be coded as a part of other signaling information in the system. According to a further modification, the T bit may not be required, if the receiver device performs the decoding

5 separately for both values of T. For example, if the bit T is not transmitted but dropped, the receiver device may first test if a header is present by using a cyclic redundancy check CRC of the header. If the CRC matches, the receiver device assumes that T=1 and the header is thus

10 present, while otherwise a value of T=0 with the header being not present is assumed.

Also, it should be noted that when the additional header including the reference indication is added, some data bits

15 are stolen for this purpose to thereby maintain the physical length of each (sub-)block constant so that the occurrence of synchronization problems is prevented. The stealing of some bits may be assumed to be uncritical, since the retransmitted bits are combined with the bits of

20 the original transmission of the data block.

Still further, particularly in connection with the above mentioned code/frequency physical references, it has to be mentioned that it is, of course, never possible to send the

25 initial and retransmitted data block transmission at the same time. Therefore, there always has to be some kind of time reference, while this can be agreed on and defined in advance to be for example a fixed number of blocks relative to the retransmission.

30

The present invention will subsequently be described in detail with reference to the drawings.

Fig. 3 represents a flowchart of the method according to

35 the present invention after (for example the above

mentioned handshake procedure has been completed and) the
receiver and transmitter have agreed on one of the above
mentioned numbering schemes which is based on the physical
location of data blocks or packets, respectively.

5

In step S10, the procedure starts. In a following step S11,
the transmitter device transmits the sequence of data
blocks. The receiver device, in turn, receives the
transmitted data blocks and checks for transmission

10   failure, as indicated in a subsequent step S12.

As a result of executing a step S13, it is determined
whether a failure in reception of a particular data block
has occurred. If no failure has been detected by the

15   receiver device (NO in step S13), the method flow branches
to the left and a receipt of acknowledgment is returned
from the receiver device to the transmitter device, step
S14. (However, in a modification, the acknowledgment need
not necessarily be forwarded, since already the absence of

20   a retransmission request could be regarded as an
acknowledgment. Alternatively, also the absence of an
acknowledgment could be regarded as a retransmission
request.) After step S14, the flow advances to step S22, at
which step, for a respective block, the procedure is

25   thereafter terminated. Of course, the method will be
repeatedly performed and check each of the blocks
transmitted in the sequence of blocks.

If, however, in step S13 a reception failure for a current

30   data block of interest has been detected (YES in step S13),
the flow branches to the right and steps S15 to S22 are
executed.

Namely, in step S15, the receiver device returns a negative

35   acknowledgment to the transmitter device, thereby

requesting retransmission of the data block the original
(first) transmission of which has failed.

In a following step S16, at the transmitter device side,
5   the retransmission request is received. In response
thereto, a flag T associated to each data block is set to a
value of "1", and a header is generated and added to the
respective data block, of which the associated flag T has
been set to "1". Then, step S17, the respective data block
10   identified by the flag T=1 and the header is retransmitted.

Subsequently, in step S18, the receiver reads the
information contained in the header, and subsequently
combines the retransmitted block, i.e. the data contained
15   in the data block, with the originally transmitted block
containing the same data. The combining is effected using
the information contained in the header and representing a
reference to a physical location of said original (earlier)
block in a sequence of transmitted blocks.
20

Thereafter, in a following step S19, a check for errors is
conducted at the receiving side. Namely, it is checked
whether the combined original and retransmitted blocks are
successfully received. Stated in other words, it is checked
25   whether the combination of the original block and the
retransmitted one can be decoded without errors. If also
after the combination of these blocks, there are errors
(YES in step S20), in a subsequent step S21, a negative
acknowledgment is forwarded to the transmitter device and
30   another retransmission is requested. Thereafter, the flow
returns to step S17 and the block is again retransmitted.

If, however, the combined blocks did not contain errors (NO
in step S20), the flow advances to step S22.
35

Then, in step S22, the flow ends insofar as the subject
block and the data contained therein is concerned.

Fig. 4 illustrates in principle a data format used for data
5   blocks transmitted according to an embodiment of the
present invention. The example represented in Fig. 4 is
based on similar assumptions as the one depicted in Fig. 2.

Namely, blocks B0, B1, ..., Bn with data X,Y, and Z,
10   respectively, are sequentially transmitted. Also, the
transmission of block B0 is assumed to have failed.

In particular, as shown in Fig. 4, the block number header
overhead has been removed and replaced by a single bit T
15   for each block. The bit T=0 indicates that the block and
the data therein are transmitted for the first time, while
after setting the bit T to the value T=1 (upon receipt of a
negative acknowledgment), this indicates that the block
concerned is a retransmitted one. Further, only in case the
20   bit T assumes a value of T=1, an additional header is
generated and added to the block. The header contains a
reference REF to the physical location of the originally
transmitted block. In the shown example, four blocks are
transmitted at time instants 0, 1, 2, and 3. The first
25   block B0 is not received correctly and has to be resent.
The repeated transmission of this block occurs at time
instant 2. At this time, the bit T which originally had a
value of T=0 then has a value of T=1 in the retransmission.
Moreover, the additional header contains a reference
30   information REF which represents the value of time when the
block was originally transmitted (REF=0).

Fig. 5 shows variations of this principle of indicating a
reference information REF to a physical location of the
35   originally transmitted block.

Fig. 5A, diagram I.) shows a further example case according
to which not the transmission time is mapped to a numbering
scheme, but according to which the transmission frequency
is mapped to a numbering scheme. Assuming a case in which
the transmitter and receiver have agreed on a numbering
scheme (e.g. in the handshaking operation), that a sequence
of blocks to be transmitted is transmitted such that for
each new block another transmission frequency is used (a
kind of "frequency hopping"). Specifically, blocks are
transmitted such that a sequence of frequencies F1, F2, F3,
F4 is used which is mapped to a numbering of 0, 1, 2, 3.
Then, if the block transmitted on frequency F1 is not
received correctly, it is retransmitted on frequency F3,
with the bit T being set to "1" and the header contains a
reference REF=0 indicating that this is a retransmission of
the block originally transmitted with frequency F1
(frequency sequence number "0").

Likewise, Fig. 5A, diagram II.) illustrates a similar case,
while however in this case a transmission code of a
respective block is mapped to a numbering scheme. That is,
the transmitter and receiver have agreed on a numbering
scheme that a sequence of blocks to be transmitted is
transmitted such that for each new block another
transmission code is used (a kind of "code hopping"). The
explanations given herein above in connection with diagram
I.) can be applied to diagram II.) with the exception that
now the code (instead of the frequency) represents a
reference to a physical location of the originally
transmitted block.

Fig. 5B (diagram III.) shows a further modification of an
adopted numbering scheme, in which the references to the
physical location of an originally transmitted block in

terms of frequency domain, code domain and time domain have been combined. It is to be noted that this only represents one example and various other modifications are conceivable.

In detail, diagram III.) represents a case of a numbering scheme (0, ..., 15) in which transmitter device and receiver device have agreed upon using two frequencies (F1,F2), two codes (C1,C2) and four time instants (0, ...,3). More specifically, while frequency F1 is selected (numbering 0,...,7), a first code C1 is selected, and during the selection F1 & C1, blocks are transmitted during four consecutive time instants (0,..., 3), i.e. numbers 0 to 3 in the numbering scheme. Then, while the frequency remains the same (F1), the code changes to code C2, and during the selection F1 & C2, blocks are transmitted during four consecutive time instants (0,..., 3), i.e. numbers 4 to 7 in the numbering scheme. Subsequently, the frequency is changed from F1 to F2, and the same procedure is repeated which corresponds to numbers 8 to 15 in the numbering scheme (outermost left column in Fig. 5B).

In this case, a reference to a physical location of an originally transmitted block is indicated in a retransmitted block header by an information REF containing a value in the range of 0 to 15.

It is also conceivable that, alternatively, the same physical sequence is defined as a nested sub-block (time domain), block (code domain), hyper-block (frequency domain) arrangement (cf. indication at the right side of Fig. 5B). Then, a reference to a physical location of an originally transmitted block is indicated in a retransmitted block header by an information REF which could assume the following format: REF=(h,b,s), wherein h

denotes a hyper-block numbering (0 or 1 in the example of
Fig. 5B), b denotes a block numbering (0 or 1 in the
example of Fig. 5B), and s denotes a sub-block numbering (0
to 3 in the example of Fig. 5B).

5

It has to be noted that the nested block scheme is not
restricted to different domains, but can also be adopted
for a single domain such as the time domain. Then, for
example (not shown in the drawings), an octet of sub-blocks

10   forms a block, and an octet of blocks forms a hyper-block.
However, the number of sub-blocks forming a block and
blocks forming a hyper-block need not be the same (as shown
in Fig. 5B). Also, the depth of nesting the block hierarchy
is not limited to three, bit can still be deeper by

15   defining other block levels (for example "mega-blocks"
consisting of hyper-blocks, etc.)

Furthermore, Fig. 5C illustrates a still further
modification. As mentioned herein above, the number of data

20   units or packets (within a e.g. sub-block or block
represented by a physical location) is not necessarily the
same for both values of T. As is apparent from Fig. 5C,
referring to an example according to which the time has
been mapped to a numbering scheme, at time instant "2" a

25   (sub-)block is indicated as a retransmitted block due to
the value of the bit T (T=1). However, while each block
having assigned a value of T=0 contains only one data unit
(data packet or data entry X,Y, and/or Z, respectively),
the retransmission block contains more than one data units

30   and also a corresponding number of additional headers, one
header for each data packet per (sub-)block.

According to the illustrated example, data packets X and Y
received at time instants 0 and 1 were not received without

35   failure. These data packets are retransmitted at time

instant "2" and the retransmitted block (or sub-block if there is a nested block arrangement defined) contains data packet X headed by a header including the reference REF=0, and contains the data packet Y headed by a header including

5   the reference REF=1. Similar as in the previous examples, the respective header includes a reference to a physical location of the initial (or earlier) transmission.

Accordingly, as described herein above, the present

10   invention proposes a method of signaling which data blocks can be combined together in an incremental redundancy communication system consisting of a transmitter device and a receiver device, the method comprising the steps of transmitting said blocks from a transmitter device to a

15   receiver device, with each transmitted data block including an information indicating whether a respective data block is transmitted for a first time or is a retransmitted block; checking, at said receiver device, whether the transmission of a respective data block has failed;

20   requesting a retransmission of said data block from the transmitter device if said transmission of said respective block has failed, and in response to receiving said retransmission request at the transmitter device side, setting said information to a value indicating that said

25   respective data block is a retransmitted block, and adding at least one header to said data block to be retransmitted, said header representing a reference to a physical location of an earlier transmission of said block in a sequence of transmitted blocks. By virtue of the proposed method and

30   accordingly adapted transmitter and receiver devices of a corresponding communication system, transmitting of a block number within a respective data block can be dispensed with, thereby reducing an overhead of transmitted data and increasing user data throughput in the communication

35   system.

It should be understood that the above description and accompanying figures are merely intended to illustrate the present invention by way of example only. The preferred embodiments of the present invention may thus vary within the scope of the attached claims.

CLAIMS

1. A method of signaling which data blocks can be combined
together in an incremental redundancy communication system
5   consisting of a transmitter device and a receiver device,
the method comprising the steps of:
transmitting (S11) said blocks (B1, B2, ...Bn) from a
transmitter device to a receiver device, with each
transmitted data block including an information (T)
10   indicating whether a respective data block is transmitted
for a first time or is a retransmitted block;
checking (S12, S13), at said receiver device, whether
the transmission of a respective data block (B1) has
failed;
15   requesting (S16) a retransmission of said data block
from the transmitter device if said transmission of said
respective block has failed, and
in response to receiving said retransmission request
at the transmitter device side,
20   setting (S17) said information (T) to a value
indicating that said respective data block is a
retransmitted block, and
adding (S17) at least one header to said data
block to be retransmitted, said header representing a
25   reference to a physical location of an earlier transmission
of said block in a sequence of transmitted blocks.

2. A method according to claim 1, wherein
said physical location of a respective block is
30   represented by mapping the time of transmission of a
respective block to a numbering scheme.

3. A method according to claim 1, wherein

- 21 -

said physical location of a respective block is
represented by mapping the frequency of transmission of a
respective block to a numbering scheme.

5   4. A method according to claim 1, wherein
said physical location of a respective block is
represented by mapping the code used for transmission of a
respective block to a numbering scheme.

10   5. A method according to claim 1, wherein
said physical location of a respective block is
represented by mapping the frequency of transmission, code
used for transmission on a respective frequency and time of
transmission using a respective code on a respective
15   frequency in combination to a numbering scheme.

6. A method according to claim 1, wherein
said block is composed of a plurality of sub-blocks
and the header represents a reference to a physical
20   location of a retransmitted sub-block in a sequence of
transmitted blocks.

7. A method according to claim 1, comprising the further
step of
25   combining (S21, S22) the retransmitted block with
other blocks using the information contained in said
header.

8. A method according to any of the preceding claims 2 to
30   6, wherein said adopted numbering scheme is agreed upon
between said transmitter and said receiver of said
communication system in an initial handshaking step.

9. A method according to claim 1, wherein
35   said information is represented by a flag (T).

10. A method according to claim 1, wherein
    said information is represented by a cyclic redundancy
check sum of the header.

5

11. A method according to any of the preceding claims 1 to
10, wherein at least one of said information (T) and said
header is encoded for secure transmission.

10   12. A communication system consisting of a transmitter
device and a receiver device, each adapted to carry out the
method according to any of the preceding claims 1 to 11.

1/6

FIG. 1

(PRIOR ART)
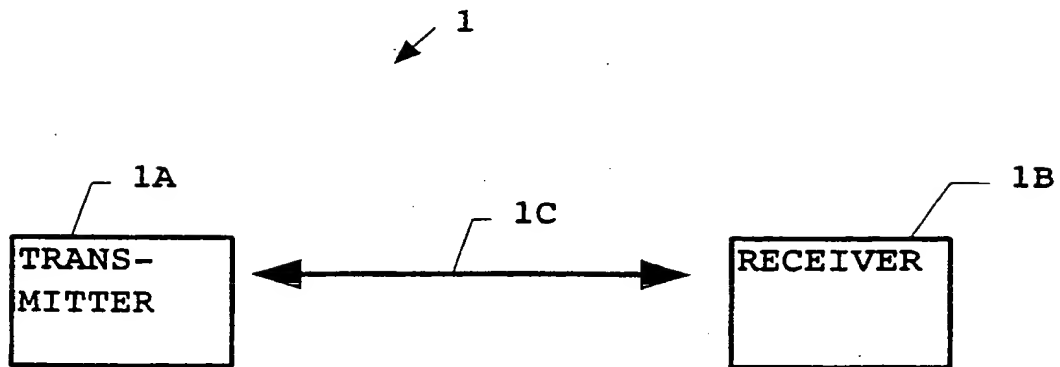
2/6
FIG. 2
(PRIOR ART)

TIME	TRANSMITTED BLOCKS	
0	BN = 546	DATA X	— B0
1	BN = 547	DATA Y	— B1
2	BN = 546	DATA X	
3	BN = 548	DATA Z	— Bn

FIG. 4

TIME	TRANSMITTED BLOCKS		
0	T = 0	DATA X	— B0
1	T = 0	DATA Y	— B1
2	T = 1	REF=0	DATA X	
3	T = 0	DATA Z	— Bn

MAPPING TRANSMISSION TIME OF BLOCK TO NUMBER

3/6
FIG. 3

START ⎯ S10

TRANSMIT BLOCKS ⎯ S11

RECEIVE & CHECK FOR FAILURE ⎯ S12

S13

BLOCK RECEPTION FAILURE?

NO

YES ⎯ S15

ACKNOWLEDGE RECEIPT ⎯ S14

NEG. ACK.; REQUEST RETRANSMISSION

REC. RETR. REQ.; SET : T -> 1; GENERATE & ADD HEADER ⎯ S16

RETRANSMIT BLOCK ⎯ S17

COMBINE USING HEADER INFO ⎯ S18

CHECK FOR ERRORS ⎯ S19

S21 NEG. ACK.

YES

FAILED ? ⎯ S20

NO

S22

END
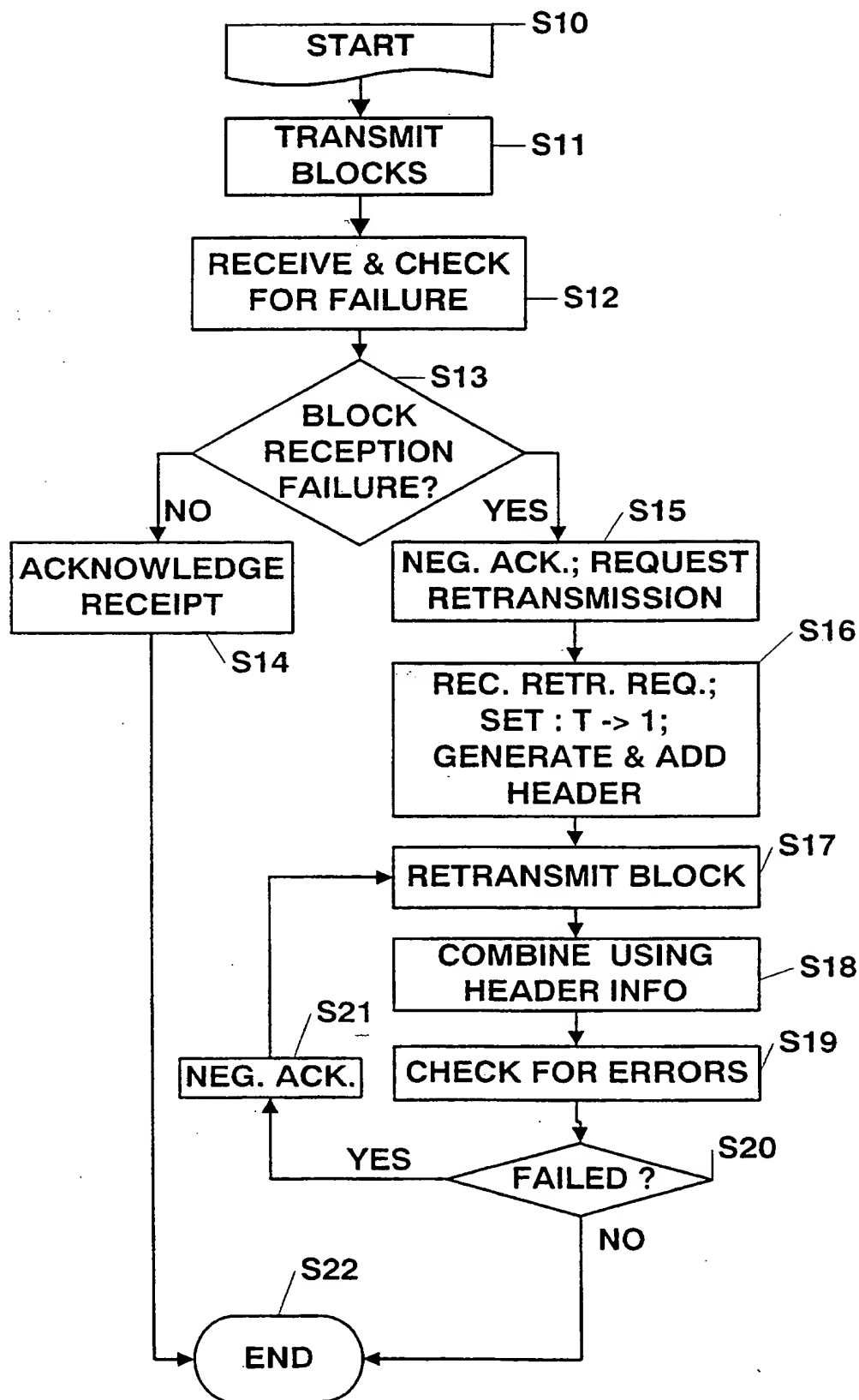
4/6
FIG. 5A

I.)

FREQUENCY   TRANSMITTED BLOCKS

0	F1	T = 0	DATA X	B0
1	F2	T = 0	DATA Y	B1
2	F3	T = 1	REF=0	DATA X
3	F4	T = 0	DATA Z	Bn

MAPPING TRANSMISSION FREQUENCY OF BLOCK TO NUMBER

II.)

CODE   TRANSMITTED BLOCKS

0	C1	T = 0	DATA X	B0
1	C2	T = 0	DATA Y	B1
2	C3	T = 1	REF=0	DATA X
3	C4	T = 0	DATA Z	Bn

MAPPING TRANSMISSION CODE OF BLOCK TO NUMBER

5/6
FIG. 5B

III.)

	FREQUENCY	CODE	TIME	
0	F1	C1	0	HYPER-BLOCK
1	F1	C1	1	
2	F1	C1	2	
3	F1	C1	3	
4	F1	C2	0	BLOCK
5	F1	C2	1	
6	F1	C2	2	
7	F1	C2	3	SUB-BLOCKS
8	F2	C1	0	
9	F2	C1	1	
10	F2	C1	2	
11	F2	C1	3	
12	F2	C2	0	
13	F2	C2	1	
14	F2	C2	2	
15	F2	C2	3	

MAPPING TRANSMISSION FREQUENCY, CODE AND TIME OF
BLOCK TO NUMBER (LEFT) OR NESTED BLOCK ARRANGEMENT
(RIGHT)

6/6

FIG. 5C

TIME		TRANSMITTED BLOCKS	

TIME	TRANSMITTED BLOCKS	
0	T = 0	DATA X	B0
1	T = 0	DATA Y	B1
2	T = 1	REF=0 DATA X REF=1 DATA Y	
3	T = 0	DATA Z	Bn

MAPPING TRANSMISSION TIME OF BLOCK TO NUMBER,
DIFFERENT NUMBER OF DATA UNITS PER BLOCK,
DEPENDENT ON VALUE OF FLAG T